MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

EEL3156 – RENEWABLE ENERGY TECHNOLOGY

(LE)

11 MARCH 2017
2:30 pm – 4:30 pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages with 5 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Give four sizes of hydro plants and their generating power capabilities. [8 marks]

(b) A Kaplan turbine has shape number $\zeta = 4$ and efficiency is about 70%. The total jets flow rate during the normal period is 1500 L/s and the turbine produces 60 kW mechanical power output.

(i) Calculate the angular speed of the shaft. [8 marks]

(ii) Find the mechanical power output during the flood period if the jet flow rate and efficiency is increasing by 60% and 10% respectively. (Assume the jet speed is same as in normal period). [4 marks]

Question 2

(a) Give three classifications of wind machines and devices. [3 marks]

(b) Briefly explain three classes of a wind turbine electricity system. [6 marks]

(c) A wind farm to be setup in an area with 60 propeller turbines. Each turbine blade has a diameter of 12 m. The measurement of air density and the wind speed for a period of a day are given in Table Q2.

Table Q2

Period of the day	ρ (kgm^{-3})	u_0 (ms^{-1})
Morning	1.4	7
Noon	1.2	8
Evening	1.0	9
Night	1.6	6

If the interference factor is 0.08, find

(i) the period of the day for the maximum power in the wind, [8 marks]

(ii) the total peak power can be extracted from the wind farm. [3 marks]

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Question 3

(a) Figure Q3 shows a typical solar water heater system. Name all the components A to D in the figure. [4 marks]

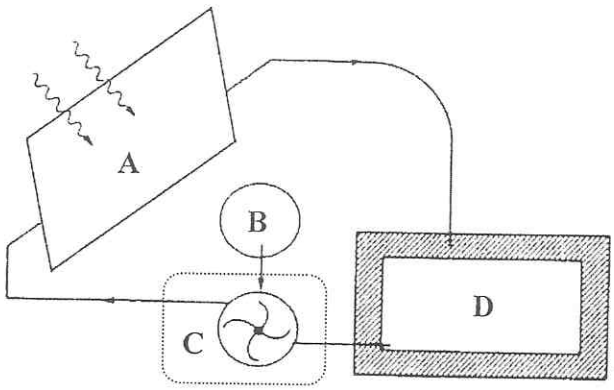

Figure Q3

(b) A flat plate collector as shown in Figure Q3 has a loss resistance $R_L = 0.15\ \mathrm{m^2kW^{-1}}$ and a plate transfer efficiency $n_{pf} = 0.85$. The glass cover has transmittance $\tau = 0.9$ and the absorptance of the plate $\alpha = 0.8$. The ambient temperature $T_a = 25^{\circ}C$ and the irradiance in the plane of the collector $G = 715\ \mathrm{Wm^{-2}}$. By assuming the plate temperature $T_p = 40^{\circ}C$, calculate the required area measurement of plate collector in order to achieve 60% collector efficiency. [10 marks]

(c) Define the photovoltaic (PV) and photovoltaic generation. Draw the equivalent circuit of a solar cell. [6 marks]

Continued .....

Question 4

(a) Briefly explain the following terms.
(i) Biomass [2 marks]
(ii) Biofuels [2 marks]
(iii) Geothermal heat [2 marks]
(iv) Geothermal energy [2 marks]

(b) Give three classifications of biomass energy and one general type of biomass energy process for each classification. [6 marks]

(c) A hot dry rock granite depth of 6 km with geothermal temperature gradient at $40^{\circ}\text{C km}^{-1}$ was measured. The minimum useful temperature as 120 K above the surface temperature T_0, $\rho_r = 2900 \text{ kg m}^{-3}$, $c_r = 840 \text{ J kg}^{-1}\text{K}^{-1}$. Calculate the useful heat content per square kilometer. [6 marks]

Question 5

(a) Discuss the main challenges to integrate renewable energy sources into the utility grid and suggest one solution for each challenge. [6 marks]

(b) Explain how a fuel cell works and draw its schematic diagram. [14 marks]

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